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ABSTRACT

This paper investigates the discourse structure of the practical demonstration, particularly the effect produced by the presence of a visual display. The Practical Demonstration (PD), as used in technical education, differs from the lecture in having a visual display; the speaker carries out an operation as he explains it. This affects the structure of the discourse in the following respects: (1) there is a feedback mechanism whereby students can ask and be asked questions; (2) the visual display gives coherence to the verbal text at all levels of discourse; (3) paralanguage (indicating, gaze direction etc.) links the verbal text and the visual display and is therefore a major cohesive device; and (4) the visual display provides an ongoing source of reference for the text. The pedagogical implications of this are that students of Technical English must be sensitized to the way the speaker uses the visual display if they are to cope adequately with technical instruction in English speaking institutions. Samples of illustrative materials are included. (Author/AMH)

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THE PRACTICAL DEMONSTRATION

An analysis of the effect on discourse structure of a visual display.

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Tom Hutchinson

Lancaster, 1978

Abstract

The Practical Demonstration (PD) as used in technical education differs from the lecture in having a visual display. The speaker carries out an operation as he explains it. This affects the structure of the discourse:

a) There is a feedback mechanism. Students can ask and be asked questions.

b) The visual display gives coherence to the verbal text at all levels of discourse. The speaker's relationship to the visual display is used as a FOCUSSING technique.

c) Paralanguage (indicating, gaze direction etc.) links the verbal text and the visual display and is therefore a major cohesive device.

d) The visual display provides an ongoing source of reference for the text. Reference need not be overtly signalled, because it presupposes the audience can see the visual display.

The pedagogical implications of this are that students of Technical English must be sensitised to the way the speaker uses the visual display to give structure and cohesion to the verbal text, if they are to cope adequately with technical instruction in English speaking institutions. Illustrative materials are included in this paper.

The Practical Demonstration: An analysis of the effect on discourse structure of a visual display

Tom Hutchinson

Introduction

Most work on study skills for overseas students of English has been concentrated on undergraduate and postgraduate courses. It is likely, however, that many future students will be working on courses below degree level.

In 1977 a group of Iranian chemical process operators followed a five-week language study course at the Institute for English Language Education, Lancaster, prior to starting their studies at Longlands College of Technical Education at Middlesbrough. A study of the syllabus and teaching methods these students would encounter at Middlesbrough showed that one of the most important means of presenting information at this level is the Practical Demonstration (PD).

The aim of this present paper is to investigate the discourse structure of the PD, in particular the effect produced by the presence of a visual display. Montgomery (1976 MS.), referring to lectures, concludes that "we need to know much more about how the visual display both shapes and is incorporated into the verbal text". Analysis of the PD, in which the visual display is the focal element, should throw some light on this relationship.

Since the PD has till now received little attention, it is only possible at this stage to pick out the main features and to review briefly their pedagogical implications. Hopefully this will provide the basis for more intensive research in the near future.

The Practical Demonstration Defined

The lecture provides a convenient reference point against which to compare the PD. It is a communicative event familiar to all academics and has been quite extensively studied, notably in the K.A.A.U. programme carried out at Birmingham and Lancaster. The defining characteristic of the PD, in contrast to the lecture, is the presence of a real visual display with which the speaker physically interacts.

The PD may be a static description of a machine or apparatus (e.g. "on the very front of the ram we have the tool holder." PD4, see below), or a dynamic description of a process or operation (e.g. "Locate the cutter in the sleeve and turn the cutter ..." PD10). In fact, most PDs contain examples of both. But in each case, the speaker carries out the appropriate indicating or operating actions as he gives his verbal explanation. In a static description the actual machine or apparatus is used with the speaker indicating the relevant parts. If the PD is a dynamic description, the actual process is carried out by the speaker.

Lectures, too, may contain a large and important visual element, but this usually takes the form of abstract representations, such as diagrams, formulae or calculations, rather than an actual object. Nevertheless, there is no definite division between the PD and the lecture in this respect. Some demonstrations must necessarily be shown at one remove from reality by means of models or diagrams. The object may be too large or too small or too dangerous to allow a 'live' demonstration. The first PD in the data used for this paper contains a section on the characteristics of an electric circuit; for convenience and generality (and probably safety, too) a diagram is used rather than an actual circuit. The rest of the PD then continues with a demonstration of a number of electronic instruments.

Conversely, the subjects of lectures may be made more concrete than they are in reality by the use of models. Molecular structure, the movement of the planets, or an administrative infra-structure might be so represented.

We do not find, then, two distinct types of presentation - PD or lecture. Furthermore, a PD may include a section which is closer to the lecture, and vice versa. But there are clear examples of each, even though between the two there is a degree of overlap.

With these observations in mind, the data have been selected according to the following criteria:

1) The major part of the demonstration must involve some piece (or pieces) of equipment.

2) The speaker must be able to touch and operate the equipment as required.

3) The equipment must be visually observable to every member of the audience.

4) If a process is being described, the actual process is carried out. (This applies only insofar as practical considerations allow. One of the PDs is a demonstration of a surveying instrument. Space would not allow this to be shown actually in use. The speaker, therefore, asks for the use of a little imagination to overcome this.)

These conditions are critical, since they characterise the relationships that exist between speaker, audience and visual display, and so determine the particular discourse structure of the PD.

In selecting the data, a number of commercial materials were considered. Many such visual aids are available to cater for the needs of technical students. The BBC and most large industrial concerns produce high quality film and video material, and several tape/slide and tape/loop productions are obtainable. These were rejected as data, however, because they reflect a different set of relationships. The commentary is usually superimposed over a film recording or slide programme, with the result that the speaker cannot touch the visual display, or point to relevant parts of it or operate it as he could in the live situation. This affects the use of gesture and reference.

In another respect, too, commercial materials are unsuitable as data for the present project. The commentaries are not the spontaneous, unprepared language of true monologue (Abercrombie, 1968), such as the student would encounter in his technical course. They are, in fact, written language delivered orally.

On these grounds, then, it was decided not to use any commercially produced materials as data, but to rely only on recordings made within the actual teaching institutions.

(I should like at this point to express my gratitude to the teachers who kindly provided the demonstrations and so made this paper possible.)

The Data

Eleven video-recordings, covering a variety of subjects and audience levels were used as data for the investigation:

PD1 Introduction to Electronic Instruments
Dr. B. K. Jones, Department of Physics, University of Lancaster. Audience: first year undergraduates.

PD2 The Engineer's Tilting Level
Dr. M. Anson, Department of Engineering, University of Lancaster. Audience: first year undergraduates.

PD3 The Video Cassette Recorder
Courtesy of Bolton College of Education (Technical). Audience: teachers and teacher-trainees.

PD4 The Omerod 16 inch Shaping Machine
Courtesy of Bolton College of Education (Technical). Audience: teachers and teacher-trainees.

PD5 Turning a Mild Steel Bush on a Lathe
H. W. Tyson, Department of Engineering, University of Lancaster. Audience: first year undergraduates.

PD6 Introduction to Welding
R. Schofield, Lancaster and Morecambe College of F. E. Audience: 13/14-year-old Secondary Modern pupils.

PD7 Positioning a Feature for Machining
J. H. Langdon, Lancaster and Morecambe College of F. E. Audience: 17-year-old craft apprentices.

PD8 Positioning a Feature using a Milling Machine
J. H. Langdon, Lancaster and Morecambe College of F. E. Audience: 17-year-old craft apprentices.

PD9 Demonstration of the Effect of Carbon Content of Steel
J. H. Langdon, Lancaster and Morecambe College of F. E. Audience: 17-year-old craft apprentices.

PD10 Fitting a Cutter into a Milling Machine
K. B. Warren, Lancaster and Morecambe College of F. E. Audience: 17-year-old craft apprentices.

PD11 Setting a Component in a Four-Jaw Chuck
M. T. Smith, Lancaster and Morecambe College of F. E. Audience: 17-year-old craft apprentices.

Although predominantly concerned with Mechanical Engineering, this corpus of 11 video-recordings contains a variety of subjects. This

should ensure that the findings are not confined to Engineering discourse, but have a general validity for the PD as a teaching medium. Except in the content and degree of knowledge which is presupposed, the subject does not seem to affect the nature of the PD. The strategies employed by the teachers to convey the information are common to all subjects.

The structure of the PD does seem to be affected, however, by the audience level. Several different levels are represented, ranging from University students and teachers to third-form Secondary School pupils. It appears that the style of the PD approximates to that familiar to the audience, following a continuum from the question/answer sequence that characterises classroom discourse (Sinclair and Coulthard, 1975) to the lecture monologue.

The present data do not allow a systematic analysis of the effects of the audience level, since not all the recordings have a 'live' audience. PDs 6-11 are recordings of actual lessons, but the first five examples are played direct to the camera with only film crew as audience. What this does allow, however, is to see the effect of the presence or absence of a live audience.

Audience Participation

Murphy and Candlin (1976) point out that despite its apparent one-man-show format, "the lecture is an interactive situation". It is not simply a monologue delivered into space which just happens to be occupied by students. Audience and speaker communicate with each other through eye-contact, gaze direction, facial expression, etc.

Nevertheless, it is assumed, rightly or wrongly, that the audience understand what is said. Unless one of the participants chooses to break the conventions by putting a direct question, feedback is only obtainable at the very delicate paralinguistic levels mentioned. There is no overt mechanism for obtaining clarification or for monitoring comprehension built into the system.

In the PD, however, there is a very real degree of feedback. The proximity of the participants standing around the piece of equipment breaks down the formal face-to-face barriers of the lecture (Hall, 1964). Students can ask and be asked questions; they can be called upon to carry out certain tasks. The situation, then, moves more towards the classroom end of the pedagogic continuum (Sinclair and Coulthard, 1975).

Audience involvement manifests itself in a variety of ways. Questions can be used as part of the ongoing monologue, so forcing the students to think actively about the process they are observing, e.g. (T = teacher; P = pupil/student):

PD6 T ... the first thing I want you to think about is that everything in here is hot or could be .. everything. For instance, suppose I ask you to pass me a firebrick from there, will you? Now what's he done wrong?

P Picked it up.

T He's picked it up. He's done er he's done exactly what the teacher's told him to do but he did one thing wrong. He should've ...

P / tested it.

T He should've just lightly ...

P touched it.

T Touched it.....

PD9 T ... we've created a weakness of brittleness. But can you give me an explanation. Why should it happen to that and not happen to that?

P Is it the carbon?

T As far as we know at this stage it must be the carbon content .....

Questions can also be used to test presuppositions or to key the demonstration into a broader framework of knowledge by drawing out information the students will have learnt in their previous work, e.g.:

PD8 T ... what type of operation could I perform when I've positioned this from this edge?

P Drilling something.

T Drilling a hole .. ..

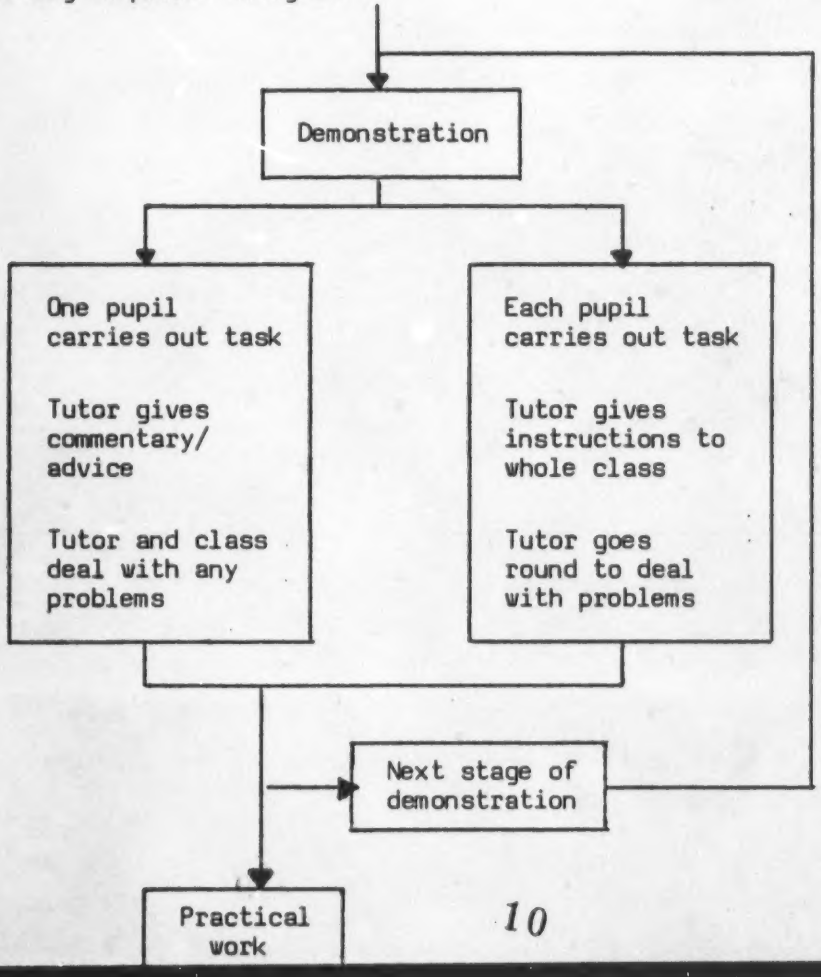
PD10 T ... now in order to do this we use this component here. Anybody tell me what it is?

P Cartson auto-lock.

T A Cartson auto-lock chuck, yes .....

The feedback mechanism in the PD enables the instructor to monitor comprehension as the lesson proceeds. He can chunk the information into convenient stages, checking comprehension before proceeding to the next section. The validity of this as a pedagogic technique is seen in Urquhart and Widdowson's (1976) finding that questions set into a written text improved the performance in the normal end-of-text comprehension test.

Monitoring comprehension in the PD can be done directly by asking the pupils to carry out the tasks themselves. For practical reasons, such as a limited number of machines, one pupil may be asked to perform the task for the group (e.g., PD7 and PD8); where possible each pupil will perform the task himself under supervision (e.g., PD6). Whichever pattern is chosen, the ultimate aim of the PD is for the pupils to use the technique learnt in the PD in individual practical work. In other words, the final comprehension test is carrying out the task itself. The following sequence emerges:


Demonstration
One pupil carries out task
Tutor gives commentary/ advice
Tutor and class deal with any problems
Each pupil carries out task
Tutor gives instructions to whole class
Tutor goes round to deal with problems
Next stage of demonstration
Practical work

Questions can also be used to monitor comprehension. This may be immediately as part of the monologue (e.g., PD6) or as a revision exercise at the end of a section (e.g., PD7).

PD6 T ... these valves are called well I've called them actually console valves. What're they called?

P Console valves.

T Console valves. These two valves are called regulating valves. What are they called?

P Regulating valves.

T Marvellous marvellous .....

PD7 T ... if I had to position a feature to an accuracy of plus or minus .05 which measuring instrument would you use?

P Vernier height gauge.

T Vernier height gauge. Very good .....

One further manifestation of audience participation in the PD is the distinction between instruction and classroom management. As the students are expected to take an active part in the PD the teacher needs to direct them, either as a group or as individuals, e.g.

PD9 INSTRUCT Now see how many hammer blows to bend this to 90 degrees. See if there is any difference from the original property.

DIRECT Would you just stand clear please.

INSTRUCT So one blow and it fractured ....

This distinction seems to be marked by a shift in key (Brazil, 1975): INSTRUCT - High Key, DIRECT (GROUP) - Mid Key, DIRECT (INDIVIDUAL) - Low Key. This is a very crude correlation. Key is not the only factor: there is a change in voice quality, too. The use of key to signal a change in discourse function is certainly worthy of more study. It is mentioned here only as another indication of how the presence of the audience affects the nature of the PD.

Audience participation, therefore, clearly sets the PD apart from the lecture as a teaching medium. Video-recordings to the camera, in that they lose the normal feedback mechanism of the PD, must be treated with caution, particularly for pedagogic purposes. Although still valid in many respects, they do not represent all the aspects of the discourse structure of the live PD.

Analysis Model

Since the Birmingham system for the analysis of lectures (Montgomery, 1976) will be frequently referred to, it will be useful to give a brief outline of it.

Montgomery's model has two parallel forms of discourse - the verbal text or DISCOURSE and the visual display or PARADISCOURSE. Each affects and is affected by the other, although little is known about the relationship.

The DISCOURSE operates on two PLANES, which are referred to as MAIN and SUBSIDIARY. MAIN DISCOURSE is concerned with "describing and explaining the phenomenon in question" (ibid.), whilst the concern of SUBSIDIARY DISCOURSE is "with monitoring, reflecting upon and commenting on the primary thrust of the DISCOURSE" (ibid.). This distinction is not a qualitative one: both planes are equally important for the transfer of information:

> "The latter [i.e. SUBSIDIARY] may be seen as necessary to the communication but not sufficient, whereas the former may be seen as both necessary and sufficient."
>
> (ibid., my brackets and insertion)

SUBSIDIARY DISCOURSE has two functions: GLOSSING, of which various types are defined, and ASIDES. The latter are less closely connected with the main thrust of the DISCOURSE. The ASIDE is used to "contextualise the DISCOURSE" (ibid.). There are two main types: the PROCEDURAL, by means of which the monologue is related to the visual display, and the RECALL, where the lecturer refers to earlier, familiar information.

MAIN DISCOURSE also contains two types, so producing the normal pattern: STRUCTURING INFORMING STRUCTURING.

STRUCTURING includes the familiar MOVES: FRAME, FOCUS, CONCLUSION.

INFORMING is the new information to be conveyed.

This resumé is not intended to be a definitive explanation of the Birmingham system, but is to provide a reference point for the analysis of the PD. The points of particular interest are the PROCEDURAL ASIDE, because of its role regarding the visual display, the STRUCTURE and the INFORM.

Coherence: Macro

Montgomery (1976), in looking at the pedagogical implications of his analysis of lectures, concludes that "the lecture ... is plainly an unwieldy and unmanageable speech event". Admittedly he was dealing with one-hour monologues, whereas the present data are only 15-20 minutes in duration, but they certainly do not seem to lack clarity.

It would be difficult to assess the influence of duration on clarity, since one-hour PDs and twenty-minute lectures are at best unusual. However, it would be surprising to find that the PD is more manageable simply because it is briefer than the lecture. Rather it is clear because at the level of the LESSON and the EXCHANGE (Sinclair and Coulthard, 1975) the discourse structure is fixed by the sequence of the process being described. The speaker does not need to juggle with the order of the information or decide on where to bring in illustrations; the decision is made already: he must simply follow through the process he is demonstrating, explaining each step as he proceeds. The demonstration, therefore, acquires the logical coherence of the process itself.

In most cases the demonstrator has little choice in how the demonstration is structured: the steps of the process can only be done in a specific order. PD1 is different in that it is not a description of a single process, but a series of descriptions of various electronic instruments. Even so within each description the logic of the process exerts its influence:

(PD1) "There are again two[1] terminals a red one for the positive and the black one for negative for D.C. measurements; for A.C. measurements the polarity naturally doesn't matter. The switches have to be arranged to give the appropriate reading. One[2] has to be er on the appropriate indication here for D.C. or A.C. measurements and the other[3] will then

indicate the type of measurement you're making - voltage or current and the range[4] of magnitude of the measurement you're making.

[Terminals already connected[1]]

For instance if you want to measure the voltage of a battery which is less just less than ten volts and D.C., we turn this[2] switch to register D.C. and this switch[3] to measure voltage ranges and as this is just less than nine volts we put it on the[4] ten volt full-scale range and we can then make the measurement ..."

(my brackets)

This excerpt has two sections, the first introducing the main controls of the instrument and the second following through a simple activity using it. The order in which the controls are introduced follows exactly the sequence in which they are brought into play in using the device.

It is probable, then, that in describing the parts of a machine the demonstrator is mentally following through the activity of operating it, and this influences the order in which the controls are introduced.

As well as determining the order of the steps in the demonstration, the visual can also influence the relationship between those steps. In the lecture the speaker must often hold a number of loose threads of the discourse in the air pending a final tying up. The speaker in the PD, on the other hand, can rely on the visual display to do this. The state of the PD at any given time is "frozen" in the state of the visual display. There is no need for the speaker to keep referring back or across to other sections because he can refer directly to the visual display. The RECALL as used to refer to earlier information in the monologue is completely absent from the present data (except in the case of comprehension questions).

At the level of the LESSON and the EXCHANGE, then, the PD is structured by the visual display - both by the order of the steps to be carried out and by the physical realisation of each step. The PD has *'per se'* a coherence and logic which in the lecture must to a large extent be created by the subjective judgement of the lecturer.

Coherence: Micro

The visual display also plays a structuring role at the MOVE level. Brazil (1975) has shown how intonation can be used to structure the discourse by marking boundaries: "A structural choice of high key .. ... indicates the separateness from what is beginning from what has gone before." (op. cit.) This compares with Sinclair and Coulthard's observation that high key is used by teachers to signal a new EXCHANGE (1975). In a similar way low key indicates finality and so marks a CONCLUSION.

STRUCTURING MOVES, therefore, need not be marked lexically, but can be indicated by the use of intonation. The present data show that the visual display and the speaker's relationship to it can similarly fulfil a STRUCTURING role. It must be borne in mind, however, that it is not possible to pin down exactly how strong an influence this has, since boundaries are frequently marked by several features, both linguistic and paralinguistic.

Certainly the PD contains many verbally expressed STRUCTURING MOVES, but in general there seems to be less need for them, e.g.:

CONCLUSION/ INFORM	Well I would consider that ready now to be more accurately set. It's set roughly. It's set as near as we can at this stage.
FRAME	So
FOCUS/ INFORM	the next thing to do is to introduce the dial test indicator [D.T.I] on to the component ...

(my brackets)

In this example, the FRAME and the intonation indicate the start of a new EXCHANGE, and in terms of the process it is an important break, marking the change from coarse adjustment to fine adjustment. But there are no definable CONCLUSION or FOCUS. The concluding statements in the first EXCHANGE and the opening sentences in the second are INFORMS, because they convey new information, viz: "the component must be roughly set to the position it is in. For the fine adjustment the DTI must be used". In other words, when opening the new EXCHANGE he does not state: "The next thing I am going to talk about is ...", which would be a

STRUCTURING MOVE, but: "The next step in the process is ...", which is an INFORM.

Yet it is quite clear that a new EXCHANGE is beginning, and what the focus of the next EXCHANGE is, because the speaker's actions give this information. He indicates the state of the component from different angles to show the critical position, and then uses the action of moving his hand towards the DTI and taking hold of it to produce a FOCUS.

An example from PD6 shows a similar absence of verbally expressed STRUCTURE. In this case there is not even an expression like "The next thing to do is ...", which it might be argued is a FOCUSSING construction.

PD6: INFORM ... Now upon that depends a great deal of your safety.

CONCLUSION You must remember that.

FRAME Now then

INFORM the gas comes from outside ...

Here there is a complete change of topic from a talk about safety to a description of the gas-welding equipment, but the verbal text has only a FRAME to mark the boundary. Again the speaker uses his own movements in relation to the visual display to do the FOCUSSING work: he stands up, turns towards the equipment and points to the gas pipes. There is no need to tell the pupils he is going to talk about the equipment; it is obvious from his actions.

This use of the speaker's relationship to the visual display as a focussing technique is very common in the PD. Although generally the FRAME is retained, examples can be found where even this is suppressed, e.g.

PD4: INFORM *Here* we have the vertical feed. This is adjusted by this hand wheel here.

INFORM *On the very front of the ram* we have the tool holder .... which can be swivelled slightly for hand adjustment.

INFORM *Here* we have a very strong hand vice which will stand the

thrust of the tool.

INFORM *On this machine* also is fitted a swivel table ...

In this example the speaker uses locatives in a marked position and with an accompanying gesture to act as a FOCUS.

A similar technique is used by the speaker in PD1; in this case there are no locatives to mark the boundaries, only the speaker's movements and the intonation.

PD1: INFORM First there's a simple moving needle meter with black and red terminals representing the negative and the positive er er contacts for a DC measurement.

INFORM The evometer is somewhat er er is a very similar meter but is more complicated and it has arrangements of switches ...

In this last example the speaker concludes the description of one device and begins the description of another, yet verbally the boundary is completely unmarked. The speaker does not say: "Right, that's the moving needle. Now, if we look at this device we'll see it's very similar. It's called an evometer ...". Such verbally expressed STRUCTURING is unnecessary, because the speaker can rely on the paradiscourse to do this work for him.

When speaking about a device he stands behind it and points to it or moves it slightly; by ceasing to have this contact with the instrument he concludes his description of it, and by moving to the next instrument and touching it, he changes the focus to that instrument. It is the speaker's relationship to the visual display then, which produces the STRUCTURING MOVES.

The presence of the visual display contributes greatly to the efficiency of the information transfer in the PD. With the STRUCTURING work done by the paradiscourse the speaker is able to start immediately in his text with an INFORM. INFORMING and STRUCTURING can be carried out simultaneously and much of the verbal clutter of STRUCTURING can be dispensed with. This streamlines the demonstration without damaging the essential work of the STRUCTURING MOVES.

Paralanguage

In addition to its normal conversational function of providing emphasis or stress, paralanguage in the PD has the two extra roles of indicating and operating.

In toto the three functions constitute a range of gesture extending from complete text-dependence to self-sufficiency. Conversational gesture is like intonation in that it has little existence independent of the verbal text. Indicating is less dependent: it has a meaning of its own, although the verbal label that usually accompanies it is necessary for the total meaning. Operating gestures, finally, are completely independent of the verbal text.

The different functions are not discrete. In operating a device the speaker is also indicating it; normal conversational gesture also involves pointing or head movements to show direction. What is remarkable about the PD is the way in which all three functions are integrated with each other and with the verbal text to produce the total communicative effect of the demonstration.

The following short extract from PD 3 illustrates this close interrelationship. The coding system is not intended to provide a model; it is a purely one-off method of illustrating the points to be made.

Coding System:

————	=	duration of hand movement
↴	=	indication of item being mentioned, or carrying out of operation being mentioned.
- - - - -	=	hand held in same position after completing gesture.
ABCD, etc.	=	reference to explanations below text.

PD3: A B

"First of all, of course, we must put the cassette of tape C D into the machine. Well on the machine the first button here is E labelled EJECT and this means that it ejects the cassette in its holder F here. We press this button G we see the cassette holder comes up out of

H
the machine and this now enables us to put the cassette into the machine.
I J
We take the cassette with the label uppermost and simply feed it into
K
the slot which is so exposed. We push the lid down firmly, make sure
L
it goes right down and the cassette is now ready to play."

Explanation of References:

A - Picks up cassette.
B - holds cassette in both hands.
C - right hand moves towards EJECT button, hovers over it, making contact on "here".
D - finger moves up to expose and indicate word EJECT on facia.
E - hand moves to indicate holder.
F - hand moves to EJECT button. Pressing begins on "press"; button clicks after "button".
G - hand moves to indicate cassette holder, then moves along holder.
H - hand moves to hold cassette.
I - cassette tilted to show label more clearly.
J - cassette put into holder: clicks into place on word "exposed".
K - hand moves to holder and presses down.
L - hand moves to speaker's side; moves rapidly forward to indicate cassette in holder, then back to speaker's side.

The timing of the gesture is very important, both the point of impact and the duration. It is closely synchronised with the intonation pattern and, therefore, with the semantic content of the utterance.

In a number of examples the action begins on the head of the tone unit and ends simultaneously with the nucleus or the end of the unit. This applies both to indicating gestures (G) and operating gestures (F/K):

F. We press the button.

G. the cassette holder comes up.

K. We push the lid down firmly.

This synchronisation often requires the action to be controlled so that it fits into the time-scale created by the verbal explanation. In J the action of inserting the cassette is slowed down so that it occupies the same length of time as the utterance: "feed it into the slot which is so exposed". Similarly the movement of the finger to the EJECT button (C) is extended to make contact with the button on the word "here". This gives emphasis to the indicating gesture.

If we isolate from the text the phrases which are accompanied by a deliberate movement of the hand, we find a telegraphic version of the text in which the important steps of the process are still quite clear:

first button here
labelled EJECT
holder here
press this button
cassette holder comes up
label uppermost
feed it into the slot which is so exposed
push the lid down firmly
cassette is now ready

Paralanguage, then, functions at several levels simultaneously and without apparently reducing the effect of any one role. The speaker's gestures are blended into the text, highlighting the important sections, and with the same actions the relevant parts are indicated and the necessary steps of the process carried out.

In this way paralanguage acts as a major cohesive device. But it should not be seen as a layer of mortar between the two separate bricks of text and display. At either end of its range it merges into the two other components of the PD: conversational gesture is text-dependent; operating gesture is part of the visual display.

Nor is this a one-way relationship with the paralanguage being adapted to key into a self-sufficient verbal text. The nature of the text itself is affected by the presence of the visual display and the speaker's ability to make use of gesture. This will become apparent when we consider cohesion in greater detail.

In this section I have dealt only with hand movements. There are, of course, many other paralinguistic means of communication available to the speaker in the PD, notably head movements and gaze direction,

which are widely used for indicating. I have concentrated on the hands, because they are the easiest to see and have the widest range of functions.

Cohesion

Halliday and Hasan (1976) define cohesion as: "... the linguistic means whereby a text is enabled to function as a single meaningful unit".

It is undeniable that the PD constitutes a meaningful unit, but its meaning depends on far more than just the linguistic element. Large parts of the verbal text are uninterpretable without the visual display and gesture, since they are made with the knowledge that the audience can see both the demonstrator and the display, e.g.:

PD2 There is a fine adjustment button here and this will move the thing small directions this way ...

PD5 So I'm going to start the lathe now and you'll see me measuring the length ...

PD7 If you're right-handed you hold the blowpipe about there just balanced nice in your hand if you hold it about here ...

PD11 Now the state that this component must be in in order for machining to be carried out is as you see it now ...

Cohesion is created by the integration of separate passages to create one text (Halliday and Hasan, 1976). But a passage need not be linguistic; it can consist solely of gesture or of a visual display. In the PD the three elements of language, paralanguage and visual display are integrated so that they form one text. They are not separate units stuck together, but are integral parts of the SAME text. Clearly, cohesion, as a two-way process, cannot be purely linguistic when it involves integrating elements, only one of which is linguistic.

The degree of cohesion between the various elements of the PD goes much deeper than the explicit references to the display quoted above. Frequently it is not possible to tell whether reference is being made to the verbal text or to the visual display.

In each of the following examples the speaker mentions an item which has previously been spoken about. The item is also present in the part of the visual display being talked about at the time. Does

the speaker, then, intend the interpretation of the item to be retrieved from the visual display or the previous mention in the verbal text?

PD10 ... and to retain the body in the machine we must use a draw bolt in the top which screws into into the body of our collet auto-lock collet.

Now we tighten

that in so

PD4 Moving to this side we have the cross feed motion shaft.

This can be driven through this link ...

PD7 surface gauge yes. Now this has what we call rough adjustment or rough setting. Unscrew and we can put *it* in the approximate position by rough adjustment and then for fine adjustment we use the fine-threaded screw to either raise *it* or lower *it*.

PD11 If we then wind the DTI towards the chuck as close to the chuck as we can get it you will also see that there is only one or two divisions deflection on the DTI at *that position*.

In none of these examples is it possible to say which element - verbal or visual - contains the referent of the italicized item. The speakers are using the whole context to provide the interpretation. In PD11, for example, the reference is not to "the position you see before you", nor to: "the position I have just mentioned", but rather to: "the position in which you see the component and whose significance you are aware of because of what I have just said about it". "That position" can only be understood as referring to the whole context of meaning generated by all the elements of the PD.

The extract from PD7 is particularly interesting in this respect, because there is a discrepancy between the verbal and the visual contexts. The logic of the verbal text would lead one to assume that the second and third "it" referred to "the surface gauge", whereas what the speaker is operating at the time is one component of the gauge, the pointer. It must be the pointer that is referred to because it is the pointer, not the whole gauge, that is raised or lowered.

The first "it" looks like a reference to both the verbal text and the visual display, whereas the second and third "it" must be referring to the visual alone, because the pointer has not previously been mentioned. This passage is indicative of the way in which visual and verbal are seen as parts of the same whole; the speaker can move freely from one to the other without overtly signalling that he is doing so.

With the pronouns and demonstrative adjectives we have dealt with till now, the speaker must be indicating that the full interpretation is to be retrieved from elsewhere in the PD. But with nouns it is often not possible to tell whether reference is intended at all:

PD3 We take the cassette with the label uppermost and simply feed it into the slot which is so exposed. We push *the lid* down firmly ....

PD6 Now we light *the flame* ... We have *the metal* across the bench that way ....

PD10 Locate the cutter into *the sleeve* and turn the cutter two or three divisions .... Then put that assembly into *the nut*. So ....

None of the italicised items has been mentioned before, so there can be no textual reference. Furthermore there are no indicating gestures to relate it definitely to the display, only operating gestures, which, even if no reference were intended, the speaker would still have to make in order for the PD to proceed.

Nevertheless it would seem strange if the speaker were not making the assumption that what he was saying would be taken as referring to the objects he was handling at the time. We have noted that this assumption reduces the need for STRUCTURING MOVES; by the same token it can make explicit reference, whether verbal or paralinguistic, unnecessary.

The presence of the visual display and the speaker's ability to interact with it have a deep effect on the verbal text. This is marked not just by the use of gesture-related locatives and demonstrative pronouns, but also by the very absence of overt reference. The text is as it is because the visual display is there.

As a text proceeds it builds up a resource of information to which the author can refer as he chooses. This reference to an earlier part of the text links the separate utterances, so producing cohesion. What characterises the cohesion of the PD is firstly that the context is generated by visual and paralinguistic as well as verbal elements, and secondly that the source of reference extends into the actual moment of speech through the ongoing presence of the visual display.

Conclusion

The PD cannot be seen as just a variant of the lecture with a large visual content. Indeed the concept of two parallel forms of communication - DISCOURSE and PARADISCOURSE - which Montgomery (1976) puts forward for lectures, is quite inappropriate for the PD. The integration of verbal text, gesture and visual display is too complex to permit any separation of the different elements.

The display gives coherence to the monologue at every level of the discourse. The speaker's actions and speech are synchronised to achieve the maximum integration between the verbal and the visual content. The presence of the visual display provides an ongoing source of reference, so producing a distinctive pattern of cohesion between the different elements.

Thus it may be the case that in the lecture the visual display "both shapes and is shaped by the monologue" (op. cit.), but in the PD it is more correct to say that the visual display CREATES the verbal text. The display constitutes a deep level corpus of meaning which the speaker interprets for his audience through language and gestures.

The extent of the difference between the lecture and the PD is best seen in the relative roles of the MAIN discourse plane and the SUBSIDIARY ASIDE. The PD, in fact, completely reverses the two.

Whereas in the lecture the ASIDE has a PROCEDURAL function in relating the monologue to the visual display, in the PD, where the display is the focus of attention, this function is part of the MAIN discourse. Conversely, points which are not directly related to the visual display take the form of ASIDES, marked by lower key of intonation, acceleration of tempo and less frequent tonic syllables (ibid.). The directions given for classroom management fall into this category.

Some other examples from the actual teaching monologue are as follows:

PD2	INFORM	It's definitely off-centre at the moment so all I do is play with these thumbscrews here.
	ASIDE	Er, there's a bit of an art in this but when you've been at it er a year or two you soon get it.
	INFORM	And I'm bringing this bubble on to level .....
PD3	INFORM	... once again we take it out, we close down the little lid and we put it back in its little box which keeps the tape dust-free.
	ASIDE	Remembering in fact that the main enemy of video-tape is dust.
	INFORM	And we of course store it on the shelf so that the label and identification are on show.
PD11	INFORM	... to prevent damage to the component we use a copper faced hammer or a copper faced mallet.
	ASIDE	Copper being soft softer than steel we should see damage to the mallet before we see damage to the component.
	INFORM	Lift the plunger of the clock away from the component ....

The controlling influence of the visual display shown in this reversal of discourse functions marks off the PD as a form of discourse quite separate from the lecture. We still need to know much more about how the presence of the visual display manifests itself in terms of communicative strategies, but from this brief piece of research it seems clear that, whether for purposes of analysis or of teaching, the essential integration of the visual and verbal elements must be maintained.

Implications for ELT

The most important implication of this research is that the PD is such a complex event that only an actual PD can fully represent the communicative strategies involved. This presents various technical problems for the language teaching institution, which is unlikely to have either the necessary equipment or technically trained staff.

Video-recordings can be used, but it must be borne in mind that these will not represent all the aspects of the normal PD discourse. Additional input for recognising questions and classroom directions and for repair strategies will be required.

An alternative is for demonstrations with models or simple apparatus to be given. Care must be exercised in this to ensure that the teachers are fully conversant with the strategies employed in giving PDs, that the technical vocabulary the students will require is not removed by simplifying the material for classroom use, and finally that the students should be able to see the relevance of work with models or with simple PDs to their target course of study.

Whichever of these substitutes is chosen, it will still be necessary to enlist the support of a technical college to provide the students with some exposure to actual PDs. We do not as yet know enough about the structure of the PD to be able to produce a reasonable facsimile for classroom use.

This problem of authenticity also affects the exercise types that can be used to exploit the input material. As Urquhart and Widdowson (1976) note in their study of reading comprehension, the only really relevant comprehension tasks are those that the student has to perform as part of his actual target course. In technical education the normal means of assessing comprehension is by getting the student to carry out the operation he has just seen demonstrated. In other words, he can comprehend and show that he has done so without uttering a single syllable.

Exercises in language work must take this factor into account. They must enable the student to show that he has understood without demanding of him a level or style of language production inappropriate to that which he will need in his technical course. Such common questions as "Explain what the speaker means by the following terms..." are inappropriate in this regard.

This is not to say that the student should do only minimal productive work. There is evidence from studies of mother tongue acquisition that language production precedes genuine comprehension: the child only really comprehends what he can actually produce. Comprehension only seems to be better because the child can exploit contextual clues, redundancy, etc. (Clark, Hutcheson & Van Buren, 1974, and Chapman & Miller, 1975). Assuming this could also apply to L2 learning, then simulation work and role-playing, e.g., giving short PDs, should help to improve genuine comprehension.

Simulation work demands of the student a greater amount of productive work than will be expected of him in his target course, but it forces him to think actively about the language which he will need to understand. It is relevant in that it is the language of his subject and not the language of English Language exercises that he is practising.

With regard to what aspects of the PD should be examined, by far the most important is the relationship of the text to the visuals. Students must be sensitised to the way in which the speaker uses the visuals to structure the monologue and to provide a source of reference.

Work on this aspect will not only enable the students to realise when reference to the visuals is being made, but will have the added bonus of transferring a large amount of the decoding process from the verbal to the visual. The more information the student can gain from understanding the speaker's use of gesture, the less he will need to concentrate on the verbal text. This reduces the burden on the student's short term memory, so enabling him to concentrate on understanding the actual process being demonstrated rather than just what the teacher is saying.

Only if students are helped in this way to interpret the particular communicative strategies employed in the PD will they be able to cope adequately with their studies in technical education.

Illustrative Materials

The discussion so far has emphasised the peculiar nature of the PD. In view of its importance in technical education, it is necessary to consider how ELT materials can be produced which will enable the non-native speaker to cope with this form of pedagogic presentation.

The teaching materials included here were devised in pilot form for the Institute for English Language Education course in 1977 (see above, p. 1). They have been subsequently revised and expanded so that they now form part of a Workshop English module for use in the final six weeks of various pre-sessional courses for technician-level students at the Institute.

The module consists of six blocks: Simple Machines, Electricity, Mathematics, Measurement, Technical Drawing, Machine Tools. Although intended to cover the main areas of study for the Engineering student, these topics are common to a number of other technical courses, too.

The materials were devised with the assistance of the Engineering Department of Lancaster and Morecambe College of Further Education, and, as part of the Institute course, the students spent one morning per week at the college receiving instruction in the topic areas outlined. In the four days prior to each session, the students used the Workshop English materials, which exposed the students both to the basic lexis for each session and to the teaching strategies they would be expected to cope with.

The effective aim of the Workshop materials is to teach the students how to retrieve information quickly and efficiently from a PD by making them aware of the strategies the teacher is using. The second function of the materials is to provide the students with techniques for note-making. This applies to taking visual notes (i.e. sketching) as well as verbal notes.

The materials to be discussed are taken from two sessions: Workshop English V and VI from the Electricity Unit, and Workshop English XIV from the Measurement Unit.

Example (a) - Workshop English V

The video-recording used for this is PD1 of the data. It is a demonstration of certain electronic instruments and their controls. The logical target behaviour of the students is to be able to sketch and label one or more of the instruments. The exercises aim to bring the students to the point where they can complete this task quickly and efficiently.

(i) Checksheet 1 focusses the students' attention on the main points of the talk - in this case, the names of the instruments and their controls. To ensure that the students are not just hearing sounds, but also have some idea of the meaning content, they must indicate whether the name mentioned refers to a control or an instrument. The clue they are given is to watch the speaker's hands; this tells them both what he is referring to and when he will give the label.

(ii) Checksheet 2 follows the same principle, but focusses in greater detail on the instruments the students will be expected to draw.

(iii) Exercise C is a problem-solving task, in which the students must establish the relationship between the types of control, what they look like and what function each can fulfil. The exercise also provides the students with some note-taking techniques for producing quick sketches. The symbols on the diagram are abbreviations for the controls they will need to represent in their drawings.

(iv) Before proceeding to the final task of drawing and labelling, students and teacher discuss ways in which the names of the controls can be abbreviated, e.g., O/O = on/off; FC = fine and continuous (Exercise D).

(v) In E, the video is stopped for 1-2 minutes to enable the students to produce a quick sketch. They then watch the demonstration once only and note down the names of the controls. The final task is to label the sketches fully from their notes.

A. Checksheet 1:

Watch the video-recording. The speaker will mention a number of electronic devices and their controls. Look at the list below:

a) In column 1 put a tick (✓) next to the devices and controls he mentions.

b) In column 2 put another tick, if it is a device. Leave the column blank, if it is a control.

Watch the speaker carefully. When he moves from one device to the next listen for the name he will give.

Make sure you know how to pronounce all the words before watching the video.

	1	2
signal indicator		
tape recorder		
button		
signal generator		
current distributor		
rotary switch		
digital voltmeter		
electronic amplifier		
barometer		
dial		
oscilloscope		
pulse generator		
evometer		
thermometer		
cathode-ray		
terminal		
knob		
signal converter		
moving needle meter		
power supply		
energy supply		
switch		
power generator		
battery		

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B. Checksheet 2:

Watch the video again. This time you will see only the part about the signal generators. In the list below, put a tick next to the controls that are mentioned for EACH device. Column 1 is the first device, column 2 is the second, and so on.

Read the list first and ask your tutor about pronunciation if necessary.

Watch the speaker's hands carefully. When he moves his hand towards a control, listen for the name he will give.

	1	2	3	4
on/off switch				
rotary switch				
red output terminal				
black output terminal				
green (earth) terminal				
co-axial socket				
cut-out				
amplitude control				
polarity switch				
sine or square wave control				
output monitor				
frequency control				
pulse control				
signal control				

Which of these controls have both a 'coarse' adjustment and a 'fine and continuous' adjustment?

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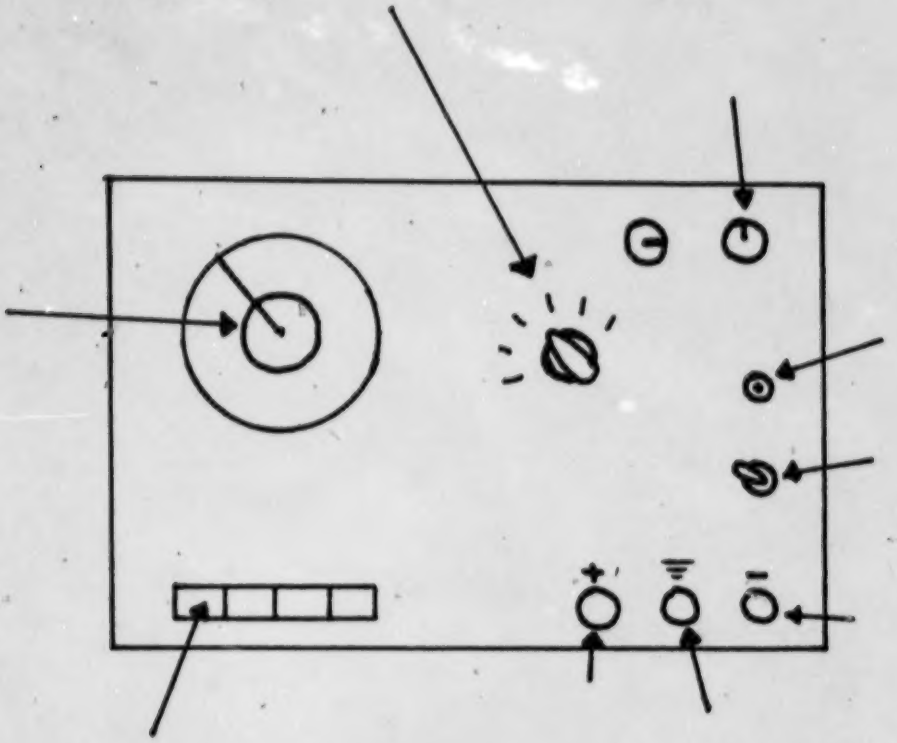
C. Use the following expressions to label the diagram:

button	positive terminal
switch	rotary switch
co-axial socket	earth terminal
dial	negative terminal
knob	



Which of these controls can be used for the following functions:

a) on/off control?.....

b) coarse control?.....

c) fine and continuous control?.....

d) output?.....

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D. In order to be able to note down the names of items quickly during a demonstration, it is best to shorten the names, and then write in the full name afterwards, when you have more time. Look at the names of the controls given in the Checksheets. Next to each name write a suitable abbreviation.

Make sure each abbreviation can only apply to ONE control. e.g., What could "CC" mean?

E. Watch the video again. Using the symbols in the diagram in C, sketch and label signal generators 2 and 3.

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Example (b) - Workshop English VI, Language Use

Each Language Use unit focusses on a particular communicative strategy employed in the preceding input unit - in this case, Workshop English V.

Workshop English VI makes the students aware of how gesture is used in the labelling process. It provides them with a strategy for isolating the words of high semantic content from the remaining mass of the discourse.

(i) Exercises A and B establish the equivalence of the various expressions for labelling - "This is the ...", "Here we have the ..." etc.

(ii) Exercises C and D show the students how gesture operates in co-ordination with the verbal text to highlight the important words. To overcome the sheer physical problem in doing these exercises of watching a video and following a transcript at the same time, this task should be organised so that each student concentrates on only one sentence of the demonstration. The results can be amalgamated in discussion afterwards.

(iii) After some practice with written examples of matching gesture and verbal text, the students proceed to simulation work, which is organised as follows: Student A has F8. This is printed on card which is scored along the dotted line. The card is folded and stood on the table so that student A can see the labelled diagram, but his partner, student B, can only see the unlabelled one. On the unlabelled diagram student A indicates and labels the components of the device. Student B has a copy of the unlabelled diagram (F7) on which he fills in the names he is given.

Roles are then reversed and the procedure repeated with a new device.

The Language Use Units, then, proceed from analysis of a teaching technique to simulation work in which the students themselves employ the technique.

Language Use: Indicating and Labelling I

A. Look at the text below. It is a transcript of the part of the video-recording you have just seen. Underline the sentences in which the speaker introduces the following controls:

a) on/off switch.

b) output controls.

c) earth.

d) amplitude controls.

1) For AC signals for AC signal sources we have signal generators and these are here we have basically the same type of arrangement. We have an on-off switch, in this case it's part of this rotary switch here: it's the first portion. You turn it on. It has the output terminals. In this case there is no earth output terminal because this is a battery model and so there is no direct connection with earth. We have an amplitude control which is coarse in factors of ten, voltage, and fine and continuous here. Being an AC signal generator it has a frequency control either coarse in factors of ten or fine and continuous here. This AC signal generator also has another functional control and that is that the signal can either be a sinusoidal wave or a square wave.

2) This signal generator is very similar. It has an on-off switch. It has terminals, red and black. Two output terminals and the green for convenience. It has an amplitude control in decades of voltage and fine and continuous adjustment. It has frequency control again in factors of ten. Frequency coarse control and a fine continuous control. It also has a sine or square wave control. Sine when this button is out and square when this button is in.

3) This is a higher-frequency signal generator, however, and it's a little bit more complicated. However, it has the same basic functions. The on-off switch is on the end of this rotary switch here. The output doesn't come between pairs of terminals

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but comes between the outside and the inside centre pin of this co-axial socket. The amplitude controls are coarse switched ranges and fine and continuous adjustment. The frequency control is again coarse switched ranges which change between the different bands here the different scales on the dial here. Then there is a fine control to change smoothly along the band or scale. These other two knobs controls we needn't bother about at this time.

4) The final signal generator is considerably more complicated than we need for the experiment but it does have the same basic controls. It's a pulse generator. It has an on-off switch. The output appears between the outside and centre pin of this co-axial socket. There's a functional control which changes the output from being a positive pulse a square wave or a negative pulse. The amplitude controls either coarse or fine and continuous and there's a frequency control either coarse or fine and continuous. The other controls and sockets we needn't bother about at this time.

B. Look at the description of signal generator 2. Note that for each control the speaker uses the expression "It has ...".

i) What does 'it' refer to?.....

ii) Re-write the description of signal generator 2, using expressions from the other descriptions, instead of 'it has...'.

.....

.....

.....

.....

.....

.....

.....

.....

.....

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C. Watch the video again. This time there will be no sound. Pay careful attention to the speaker's hands.

D. Watch the video once more. On your transcript put a mark at the point where the speaker's hand touches the control he is talking about. Do this for signal generators 1 and 3.

E. i) Look at the description of signal generator 2. Mark where you think the speaker indicates the controls.

ii) Do the same for your re-written description.

F. Simulation Work. Giving demonstrations.

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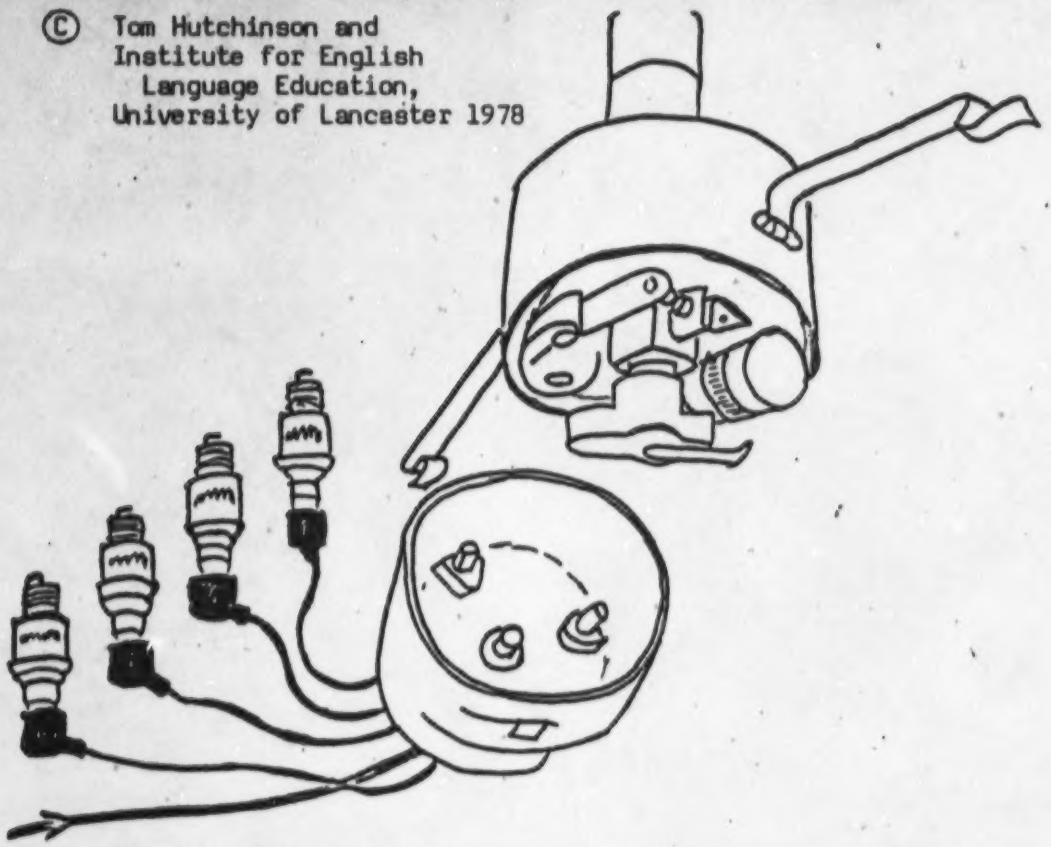
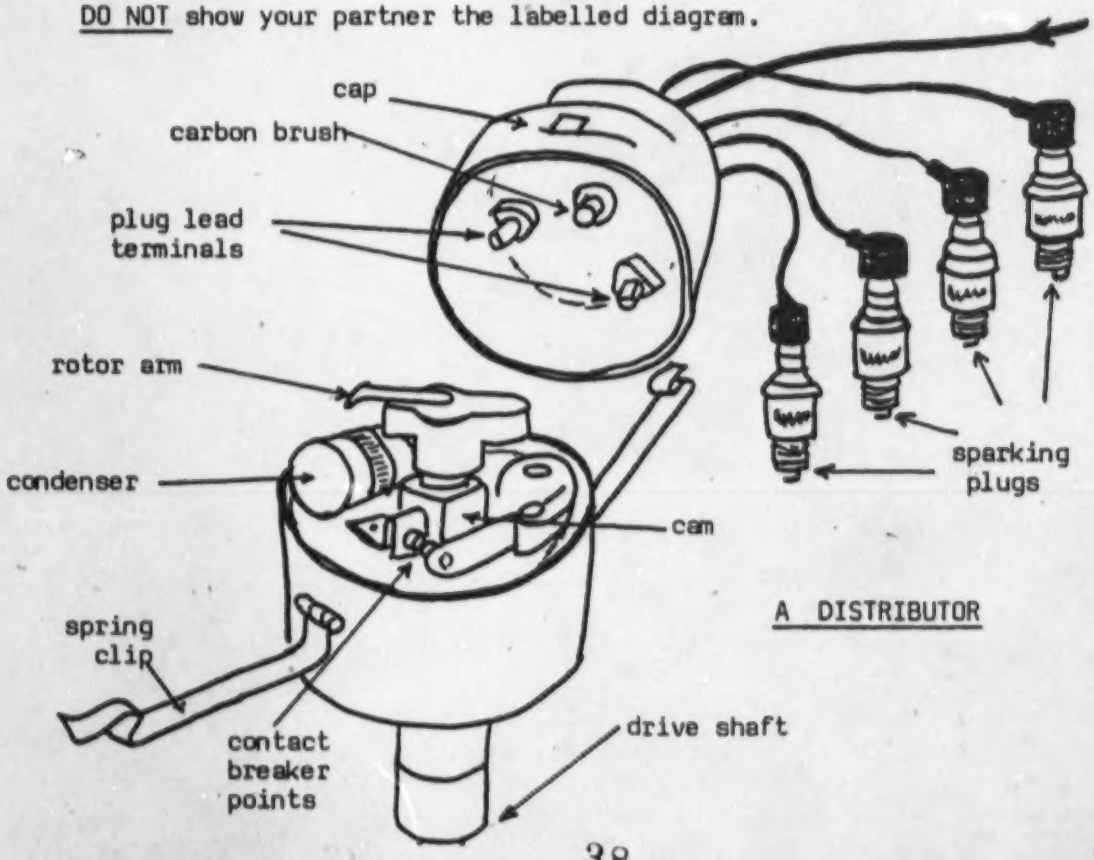


F8. Look at the diagram. Describe it to your partner, indicating the controls and telling him their names.

Use only the unlabelled diagram to indicate the components.

DO NOT show your partner the labelled diagram.



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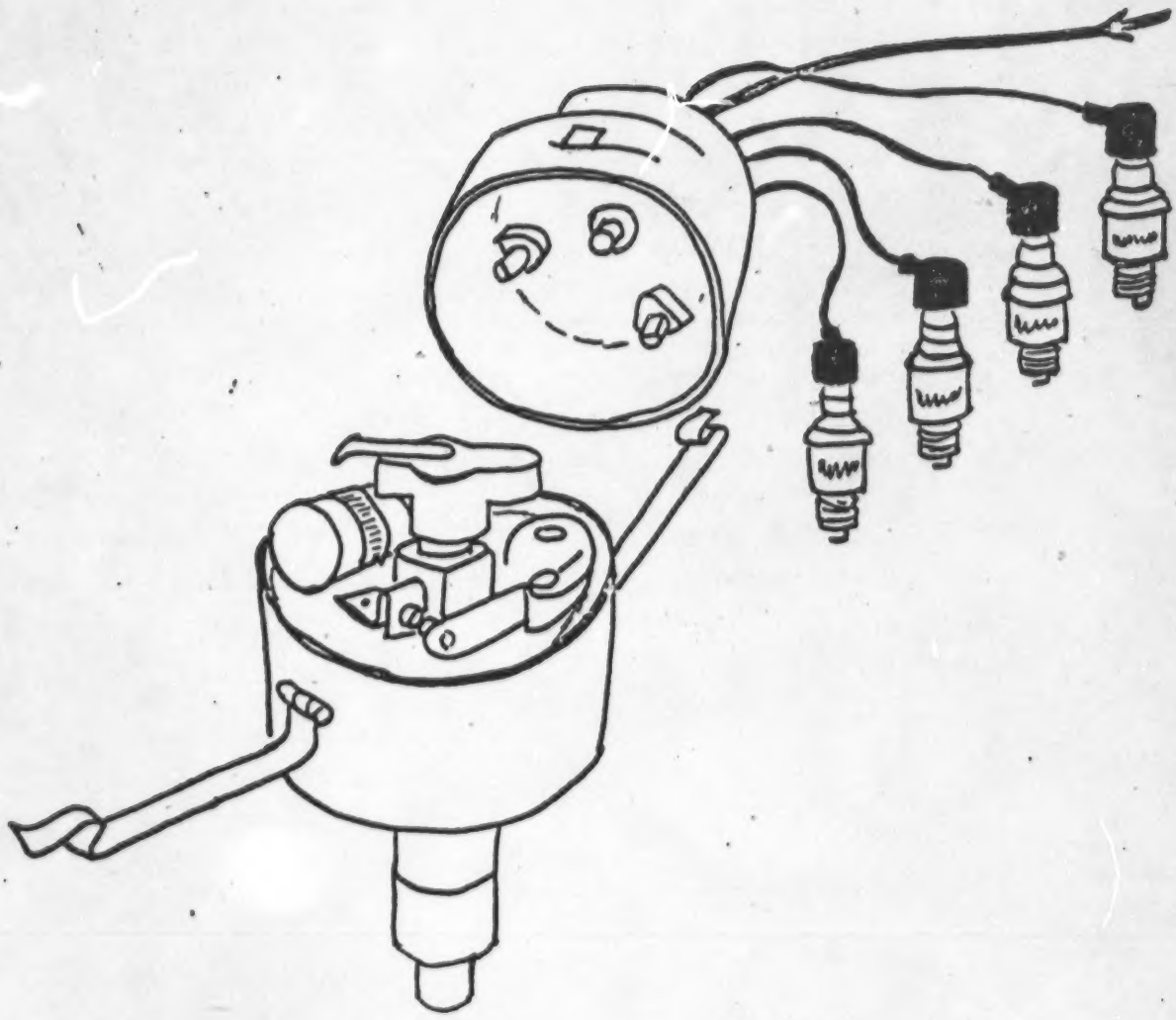
F7. Look at the diagram. Your partner will tell you the names of the components. Label the diagram from the information he gives you.



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Example (c) - Workshop English XIV

As an alternative to the use of video material, 'live' demonstrations can be given, although this does assume a reasonable level of technical knowledge on the part of the teacher.

In this example, the teacher demonstrates the main parts of a micrometer, using a large wall-mounted diagram, and explains how it is used. The students sketch the instrument and label it, and make notes on the other information in the talk.

After the talk, the students are given worksheets which they complete from their notes. The worksheet answers contain all the information that good notes would contain. The completed worksheets can then be compared with the students' original notes. Differences in the amount of information recorded can be discussed and problems remedied.

It should be emphasised that the teacher's notes are not intended to be simply read out. They provide only the INFORMING moves for the demonstration. The teacher must deliver this information within an appropriate STRUCTURE. These necessary STRUCTURING moves cannot really be prescribed in the notes since they will vary according to the needs of the students and the personal style of the teacher.

Teacher's Notes - Workshop English XIV - Note Taking

Deliver a short presentation of the micrometer, using the wall-mounted picture as necessary. Students should take notes. Allow students time to make a quick sketch of the micrometer before starting the lecture. The words underlined are needed to complete the diagram on the worksheet. Be sure to indicate them clearly.

DO NOT read out the passage. The following information is for your guidance only. Deliver the information in a manner appropriate to an oral presentation. Adjust the speed and structure of the delivery as you consider it necessary for the students to comprehend it.

The Micrometer

The micrometer is used for measuring small distances very precisely. It is a precision instrument and because of this must always be handled with great care. If it is handled roughly, or dropped, it will not give the accurate readings needed in engineering work. So always handle the micrometer carefully.

The instrument consists of a semi-circular frame. On the inside of the frame at one end there is a small button of metal called the anvil. The other end of the instrument is more complicated, involving a series of cylinders, one inside the other.

Extending from the cylinder into the U-shaped gap is the spindle. This has the same diameter as the anvil and will extend to meet the anvil.

The spindle screws inside the barrel, which is attached to the end of the frame. Over the barrel fits the widest of the cylinders, which is called the thimble. It is tapered at the end nearest the frame, so that it fits snugly around the barrel. The barrel and the thimble are both calibrated. To the end of the thimble is attached the ratchet.

To operate the micrometer, the object to be measured is placed in the frame so that the anvil gently touches one side of the object. Then the ratchet is turned until the spindle gently touches the other side of the object. A reading is then taken from the barrel and the thimble. The barrel shows the coarse measurement (i.e. to .5 of a millimetre), the thimble shows the fine measurement to two decimal places, i.e., to within .01 of a millimetre.

To hold the spindle in a position until a reading has been taken there is a locknut where the barrel joins the frame.

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A. From the notes you have made. Complete this diagram.

B. Put a tick by the correct answers:

1. A micrometer

   can be treated roughly.
   should always be handled with care.
   will not be affected if it is dropped.

2. The object to be measured goes:

   between the barrel and the thimble.
   between the ratchet and the anvil.
   between the spindle and the anvil.

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3. Readings are taken from

the barrel.
the thimble.
the barrel and the thimble.

4. To operate the micrometer you turn

the ratchet.
the thimble.
the barrel.

5. The micrometer should be adjusted until

there is a gap of 1 mm. between spindle and object.

spindle and anvil grip the object tightly.

spindle and anvil lightly touch the object.

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Indicating and labelling are fundamental aspects of the PD and it is therefore vital that students understand the strategies employed by teachers in these processes. But there are many other aspects of equal importance dealt with in the Workshop English materials. These include: explaining how a device works, distinguishing between "this" referring to the visual display and "this" as anaphoric textual reference, recognising the language of classroom management as distinct from pedagogic instruction, comparing oral instructions with written instructions, repair strategies, etc.

The adaptation of discourse analysis to ELT teaching and teaching materials is still very much in its infancy. There is an urgent need for realistic exercise types and effective methods of presentation. The materials discussed in this paper represent the techniques which are being used in the Workshop English Units employed at the Institute for English Language Education, University of Lancaster. It is hoped that they show the potential for the use of video-recordings and 'live' demonstrations in helping students to cope with this important aspect of technical education - the Practical Demonstration.

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